Internal and External Load Responses between Congested and Non-Congested Matches in Youth Soccer Players

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June 25th 2018

This Research Project is submitted as partial fulfilment of the requirements for the degree of Master of Science, St Mary's University

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Acknowledgements:

I would like to express sincere gratitude to my supervisor Stephen Patterson for his full support and expert guidance throughout my study. I would also like to thank all the members of Al Sadd Sports Club for their great support during my data collection. Finally, I would like to thank my family to encourage myself during all times. I would not have been able to complete this thesis without their continuous love an encouragement.

Abstract

The aim of our study was to investigate the internal and external load responses between matches played under congested and non-congested conditions. Data from 10 competitive youth soccer players (mean age 18 ± 1 years, height 175.50 ± 0.05 cm, weight 67.64 ± 11.07 Kg) was collected across 8 matches during 35 days. Several measures of internal (perceptual recovery, sRPE and HR) and external (TD, VHIA and P_{met}) load were assessed. Magnitude based inference was used to compare any temporal changes between two conditions. Our results suggest that internal and external load measures of youth soccer players were not affected during a short period of congested matches. Independent of match conditions, there were substantial impairments in perceived recovery post (48 and 46 %; ES: -1.42 ± 0.30, -1.53 ± 0.34), post 24 h (30 and 28 %; ES: -1.06 ± 0.36, -1.15 ± 0.44) and post 48 h (16 and 12 %; ES: -0.74 ± 0.40, -0.67 ± 0.51) for congested and non-congested matches respectively. Moreover, perceived recovery return to baseline at 72 h post-match. Our results provide important information for coaches to schedule training sessions and recovery strategies during congested fixtures.

Keywords: Match performance, recovery, training load

1. Introduction

The modern soccer calendar for elite players comprises an average of 220 training sessions and 60 matches across the season (Strudwick, 2012). This means that soccer players may have a monthly average exposure of 20 training sessions and 5.5 competitive matches. However, there are stages throughout the annual calendar where different competitions are played simultaneously and players are sometimes required to participate in a high number of matches during a short period of time (Dellal, Lago-Peñas, Rey, Chamari, & Orhant, 2013). These periods are commonly referred as fixture congestion and have been reported both at elite (Dupont et al., 2010; Dellal et al., 2013; Silva et al., 2017) and youth levels (Arruda et al., 2015; Buchheit et al., 2011; Rowsell et al., 2011). Exposure to long periods of congested matches has been shown to potentially increase mental and residual fatigue, decreasing neuromuscular performance over the following 72 h (Morh et al., 2016; Rollo et al., 2014) and increasing the risk of injuries in the matches (Bengtsson et al., 2013; Dellal et al., 2013; Dupont et al., 2010). Therefore, understand better fatigue and performance responses during congested periods is pivotal for the optimal management of the training process, squad rotation and the implementation of appropriate recovery interventions.

Soccer match related fatigue is resultant of a combination of central and peripheral factors (Rampinini et al., 2011) that seems to remain altered over 72 h post-match (Silva et al., 2017). However, most of the studies observing the time course of the recovery phase have included data from adults (Ascensao et al., 2008; Ispirlidis et al., 2008). Therefore, much less is known with regards to the recovery kinetics of younger counterparts. It has been suggested that youth soccer players experience less post-match fatigue compared with professionals (Djaoui et al., 2016). The lower muscle mass and force production ability in youth might be accompanied with a reduced amount of muscle damage which in turn causes less homeostatic disturbances

(Buchheit et al., 2011). Furthermore, despite match running activity increases with age, the number of high intense actions are often lower in youth than those reported with adults (Buchheit et al., 2010; Vieira et al., 2018). Given the degree of neuromuscular fatigue is directly associated with the number high intensity activities, it can be argued that youth might recover faster because they have less to recover from (Nedelec et al., 2014).

During congested schedules, the degree of fatigue is related to the duration of the congested schedule and the recovery time between subsequent matches. For example, during these periods the impaired ability to sprint, jump, and perform repeated intense exercise is associated with playing competitive matches twice a week over the duration of 6 but not 3 weeks (Rollo et al., 2014). Equally, repeated sprint performance, markers of muscle damage and oxidative stress were all deteriorated during a 3 matches microcycle week (Morh et al., 2015). However, this was only observed when time to recovery was shorter than 96 h. Whether a short period of matches played under congested conditions is sufficient to impact the time course of the recovery in competitive youth soccer players is relatively unknown.

The increased number of competitions during the annual soccer schedules motivated sports sciences researches to better understand the causes that these dense periods may have on player's physical performance during the match. Therefore, previous studies have compared the effect of short (Carling et al., 2011; Silva et al., 2017) and long exposures (Dellal, et al., 2013; Dupont et al.,2010) to fixture congestion. Hence it has been suggested that elite players are able to maintain their physical performance (i.e. total distance running at different speed zones) during subsequent matches (Dellal, et al., 2013; Dupont et al., 2010; Silva et al., 2017). Conversely, at youth level most studies having shown congested matches schedules to impair running performance (Buchheit et al., 2011; Rowsell et al., 2011). However, previous studies have collected data during tournaments or matches played with very short recovery time (i.e.

4 matches in 4 days). This type of calendar less resembles the annual schedule of competitive youth soccer players where subsequent matches are played respecting at least 72 h rest suggested by FIFA (Soligard et al., 2016). Therefore, there is a paucity of research that have looked at player's response to congested periods during a normal competitive schedule where matches are played twice and occasionally three times a week.

The use of global positioning system (GPS) provides a valid, reliable and time efficient approach to measure physical demands of team sports athletes and is now a commonplace during training and matches (Coutts et al., 2010; Varley et al., 2012). Moreover, the portable nature of this device facilitates its use in different scenarios such as when playing away. The use of this technology has recently been approved during official competitions (Medina et al., 2017) and since then practitioners start to use GPS during official matches (Torreño et al., 2016). However, there is not yet a common sense in the literature to report velocity zones, therefore making comparisons between studies difficult (Gabbet, 2015). Furthermore, previous research with GPS has reported running patterns based on predefined speed thresholds (Mohr et al.,2016; Torreño et al., 2016) which may have ignored individual physiological dose responses (Lovell & Abt, 2013). Overall distances at different speeds reflect just in parts the total match demands, as accelerations and decelerations can increase the energy expenditure by the same distance running by 15 % (Osgnach, Poser, Bernardini, Rinaldo, & Di Prampero, 2010). The use of metabolic power (P_{Met}) has been emerged as an alternative to add in the interpretation of the match data (Ogsnach et al., 2010). This concept is based on the principle that accelerate and decelerate on a flat terrain is energetically equivalent to uphill/ downhill at constant velocity on an equivalent slope (Di Prampero et al., 2005). Since the energetic cost of uphill/downhill is constant, acceleration and deceleration at horizontal surface can be estimated by multiplied the energy cost by the velocity to obtain the $P_{Met.}$ (Ogsnach et al., 2010). Therefore, the use of P_{met} may provide an insight of the real match demand and metabolic cost of high intensity activities such as acceleration and deceleration which are the crucial actions during a soccer match (Osgnach et al., 2010).

The high number of matches and the short recovery time available during fixture congestion make the use of traditional methods to quantity fatigue such as maximal performance tests unfeasible (Thorpe et al., 2015). Research therefore suggest that during these dense periods a tool that is time efficient, valid, reliable and sensitive to measure signs of fatigue should be preferred (Thorpe et al., 2016). Most recently, the use of subjective questionnaires commonly known as athlete self-report measures (ASRM) has been received an increased attention for the majority of the soccer clubs (Saw, Main, & Gastin, 2015). The ASRM accounts for the players well-being and its popularity is based on being quick, cheap and not requiring specific equipment or training experience (Thorpe et al., 2016). Aside from its practical benefits, they have been observed to reflect acute and chronic training loads with superior sensitivity and consistency comparing with some objective measures (Saw et al., 2015). Previous research in elite soccer players has been shown ASRM to be sensitive to detect fluctuations in training loads (Thorpe et al., 2016), inclusive at different phases of the season (Fessi et al., 2016). However, much less in known with regards to the time course of the perceived recovery during congested periods, particularly during in season phase with competitive youth soccer players. This information is relevant since disturbances in the relationship between training and recovery has been observed to increase the likelihood of injuries (Bourdon et al., 2017).

Information around the burden caused by congested schedules have meaningful implications for modulating training programmes and individualize recovery strategies. Hence, a more holistic approach to account for changes in performance and fatigue is required (Carling et al., 2015). Therefore, the aim of this study was to compare the internal and external load responses across a short period of the in season phase where matches were played under congested and non-congested conditions. It is hypothesized that exposure to a short period of congested matches might not be sufficient to affect the internal and external load responses in competitive youth soccer players.

2. **Material and Methods**

Participants

With consent from the club to conduct research and institutional ethical approval 10 (4 defenders, 5 midfielders and 1 forward) outfield male youth soccer players (mean age 18 ± 1 years, height 175.50 ± 0.05 cm, weight 67.64 ± 11.07 Kg) from the same professional club provided a parent and participant inform consent to participate in the study. Data was collected during the competitive phase (35-day) where 8 official matches were played on days 1, 4, 7, 14, 17, 28, 32 and 35 (4 home and 4 away). Matches 2, 3, 5, 7 and 8 were played within a congested schedule while 1, 4 and 6 on non-congested. In order to be included each outfield individual player needed to fulfil two criteria: a) injury free and b) participated on both conditions in at least 85% of the total match time (Dellal et al., 2013; Silva et al., 2017). The training load was recorded during the study period (21 training sessions) and non-recoveries strategies were utilized. The team played with the same tactical formation 4-3-3 during the 8 analysed matches and yield 7 wins and only one single draw with 23 goals scored and 3 considered. The level of the opponents was classified as strong (< 6^{th}) and week (> 6^{th}) according with current league position (12 teams). All matches were played in 2 x 45 min with 15 min interval in an official natural field (70 x 100) with 11 players aside. The mean and SD temperature and humidity were 24 ± 3.1^{o} C and 55± 11 %, respectively (Figure 1).

Match	1			2			3							4			5											6				7			8
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Rank	4			2			3							7			6											9				cup			10
Result	2x0			1x1			2x1							2x0			3x0											5x1				3x0			5X0
Type of training		Active Recovery	R.A + Tactical		Active Recovery	R.A + Tactical		OFF	Active Recovery	Gym + Technical	HIT + Technical	OFF	R.A + Tactical		Active Recovery	R.A + Tactical		OFF	Active Recovery	Gym + Technical	HIT + Technical	OFF	Gym + Technical	HIT + Technical	Tehnical	OFF	R.A + Tactical		OFF	Active Recovery	R.A + Tactical		Active Recovery	R.A + Tactical	
Monitoring	GPS + PRS + RPE	PRS+RPE	PRS+RPE	GPS + PRS + RPE	PRS+RPE	PRS+RPE	GPS + PRS + RPE	PRS	PRS+RPE	RPE	RPE		RPE	GPS + PRS + RPE	PRS+RPE	PRS+RPE	GPS + PRS + RPE	PRS	PRS+RPE	RPE	RPE		RPE	RPE	RPE		RPE	GPS + PRS + RPE	PRS	PRS+RPE	RPE	GPS + PRS + RPE	PRS+RPE	PRS+RPE	GPS + PRS + RPE

Figure 1. Schematic showing contextual factors, training and match schedule of the 35-day in season period. GPS: global positioning system; PRS: perceived recovery scale; RPE: rate of perceive exertion.

Dark gray shading indicates matches played under congested conditions and light gray non-congested.

Physical tests

Players were tested for maximum speed sprint (MSS) and 30-15 intermittent fitness test (IFT) one week before the commence of the study (Buchheit, 2010). The MSS was measured during 40 m sprint. Players started the sprint from a standing position with their front foot 0.5 m behind the first timing gate and were instructed to accelerate maximally during 40 m (Race Time 2, Microgate S.r.I., Via Stradivari, 4, 39100 Bolzano – Italy). Subjects performed 2 trials with at least 3 min of rest in between and time for each split (e.g. 10, 20 etc.) was measured to the nearest 0.01 s. MSS was defined as the fastest 10m split obtained during test (Mendez-Villanueva et al., 2010). The intraclass correlation coefficient values of the 40 m sprint test have been observed to be between 0.94-0.99 (Winchester, Nelson, Landin, Young, & Schexnayder, 2008). After players being fully recovered (~10 min) an incremental 30-5$_{IFT}$ was used to assess the intermittent fitness capacity and maximum heart rate (HR$_{Max}$). The velocity attained during the last completed stage was taken as the final velocity in the intermittent fitness test (V$_{IFT)}$. This test has been shown to have good test-retest reliability with a typical error of measurement of 0.3 km/h (ICC = 0.96), suggesting a potential difference of about 1 stage or 0.5 km/h (Buchheit, 2010).

Internal load

Perceptual recovery was measured using a novel perceived recovery scale (PRS) (Laurent et al., 2011). PRS was collected on a scale of 0 (very poorly recovered/extremely tired) to 10 (very well recovered/highly energetic) with players asked "how do you feel?" approximately -30 minutes before start the match (pre) 15 min after the match ends (post) at 24 hours (post 24 h) and 48 hours (post 48 h) after each single match. In the case 24 h or 48 h post-match being a day off, the PRS was self-reported via mobile phone and the respectively resulted added to the player profile. Players were familiarized with the use of the scale as part of the club fatigue monitoring protocol.

The training and match load was quantified with the rate of perceived exertion (RPE). RPE was assessed approximately 30 min after all matches and training sessions using the modified CR10 Borg's scale (Foster et al., 2001). In order to quantify the training and match load the session RPE (sRPE) was calculated as: RPE in arbitrary units (AU) × playing time (minutes) (Foster et al., 1996). The sRPE has been shown a reliable and valid measure of internal training load in soccer (Impellizzeri, Rampinini, Coutts, Sassi, & Marcora 2004). Heart rate (HR) was continuously recorded during all matches with HR belts (Polar, Kempele, Finland) connected with GPS unit and reported as individual percentage of HR_{Max} attained during the $30\text{-}15_{IFT}$. HR was then classified based on the percentage of total played time spent in each of the following zones: HR_{low} (< 80 % HR_{Max}) and HR_{high} (> 80 % HR_{Max}).

External load

Players external load during the matches was measured with a 10 Hz GPS device (Optimeye S5, Catapult Innovations, Australia). The GPS units were turned on just before the warm-up (~ 30 min) prior the match to enable acquisition of the satellite signals. Players were fitted with GPS unit located at upper back between the scapulae housed in a tight-fitting garment to reduce movement artefact. During the period of data collection, players used the same GPS unit to reduce the measurement error (Jennings, Cormack, Coutts, Boyd, & Aughey, 2010). Following each match, GPS data was downloaded using the same proprietary software (Catapult Sprint v5.0.6). The raw data provided by the software was then transferred to a personalized Microsoft Excel spreadsheet (Microsoft, Redmond, USA). Match running intensity distribution was categorized into: 1) low intensity running (LIR); 2) high-intensity running (HIR); 3) very high-intensity running (VHIR) and 4) sprint (SPR) and individualized according with player's physical test results for MSS and V_{IFT} (Buchheit & Laursen, 2013; Hunter et al., 2015). The classification of the match running distribution can be observed in Table 1. Total distance (TD) covered was the sum of the 4 categories mentioned above (LIR+HIR+VHIR+SPR) while very high intensity activities (VHIA) was calculated as the sum of (VHIR +SPR) (Buchheit et al., 2011).

Table 1. Classification of speed zones for different techniques to determine the match-play intensity distribution**.**

Match running distribution		
	MSS	V_{IFT}
Low speed run (LSR)	< 49 %	< 85 %
High speed run (HSR)	50 – 59 %	86 – 99 %
Very high speed run (VHIR)	60 -79 %	100 – 129 %
Sprint (SPR)	>80 %	>130 %
Very high intensity activities (VHIA)	> 60 %	> 100 %

MSS: maximal speed sprint: V_{IFT}: Final velocity in the 30-15_{IFT}.

The P_{met} was categorized into low P_{Met} ($\leq$ 20 W·kg^{-1}) and high P_{Met} (> 20 W·kg^{-1}). Distance was then estimated by multiplying the time spent each of the zones by the average running speed (m.s $^{-1}$) at any given moment during the match (Ogsnach et al., 2010). Other measures such as peak P_{met} (W/kg) were also assessed through the GPS device (Hoppe, Baumgart, Slomka, Polglaze, & Freiwald, 2017). Then the results added to a spreadsheet were all P_{met} variables were analysed. The use of GPS has been shown valid and reliable to track players running activities and P_{met} data (Coutts, & Duffield, 2010; Rampinini et al., 2015; Varley, et al., 2012). To enable comparisons between those who played ≥ 85 % of the total match time running distance at different thresholds was divided by the effective playing time and reported as meters per minute (m/min).

Statistical analysis

Data were log transformed before statistical analysis to reduce bias due to the nonuniformity of error and analyzed using the effect size (ES) statistic with 90 % confidence intervals (CI) and percentage of differences to determine the magnitude of effects. ES statistics was classified as trivial (< 0.2), small (0.2-0.6), moderate (0.6-1.2) and large (> 1.2). Meaningful changes in dependent variables were accessed [i.e. superior to the smallest worthwhile changes (0.2 multiplied by the between participant SD) based on Cohen's d principle]. Quantitative chances of higher or lower changes were assessed qualitatively as follows: < 0.5 % most unlikely, 0.5 % to 5 % very unlikely, 5 % to 25 % unlikely, 25 % to 75 % possibly, 75 % to 95 % likely, 95 % to 99.5 % very likely, > 99.5 % most likely (Hopkins, Marshall, Batterham, & Hanin, 2009). If the 90 % of the CI overlapped small positive and negative values, the magnitude was deemed unclear. Pearson correlation coefficient was utilized to determine the relationship between internal and external loads. The following criteria was adopted for interpreting the magnitude of correlation between measures: ≤ 0.1 trivial, > 0.1-0.3 small, > 0.3-0.5 moderate, > 0.5-0.7 large, > 0.7-0.9 very large and > 0.9-1.0 almost perfect (Hopkins et al., 2009).

3. **Results**

Internal load

Data were reported as mean ± SD. Internal load was large and most likely lower during the training (114 ± 54.74 vs 318 ± 110; -205 %, ES: -1.48 ± 0.52) with no clear changes in the match (512 ± 131 vs 478 ± 100; 5.7 %, ES: 0.24 ± 0.46) between congested and non-congested conditions respectively. There was a likely small reduction in percentage of time spent at HR_{high} during first half in congested compared with non-congested matches (66 ± 15 % vs 71 ± 12 %; -9 %, ES: -0.38 ± 0.44). However, unclear effects were observed in the second half (56 ± 15 % vs 59 ± 17 %; -3.4 %, ES: -0.12 ± 0.50) and full time (61 ± 13 % vs 65 ± 13 %, -6.3 %, ES: -0.28 ± 0.47) for congested and non-congested fixture respectively. Impairments in the time course of perceived recovery during congested matches were most likely large post (6.77 ± 1.18 to 3.74 ± 1.37; -48 %, ES: -1.42 ± 0.30) most likely moderate post 24 h (4.97 ± 1.60; -29.6 %, ES: -1.06 ± 0.36) and very likely moderate post 48 h (5.77 ± 1.31; -15.7 %, ES: -0.74 ± 0.40). Similarly, reductions in non-congested matches were most likely large post (6.86 ± 1.21 to 3.82 ± 1.18; -46.2 %, ES: -1.53 ± 0.34) most likely moderate post 24 h (5.05 ± 1.03; -28.2 %, ES: -1.15 ± 0.44) and very likely moderate post 48 h (5.95 ± 0.95; -11.6 %, ES: -0.67 ± 0.51). No meaningful changes in perceptual recovery was found between the two conditions during the four time points. (Figure 2).

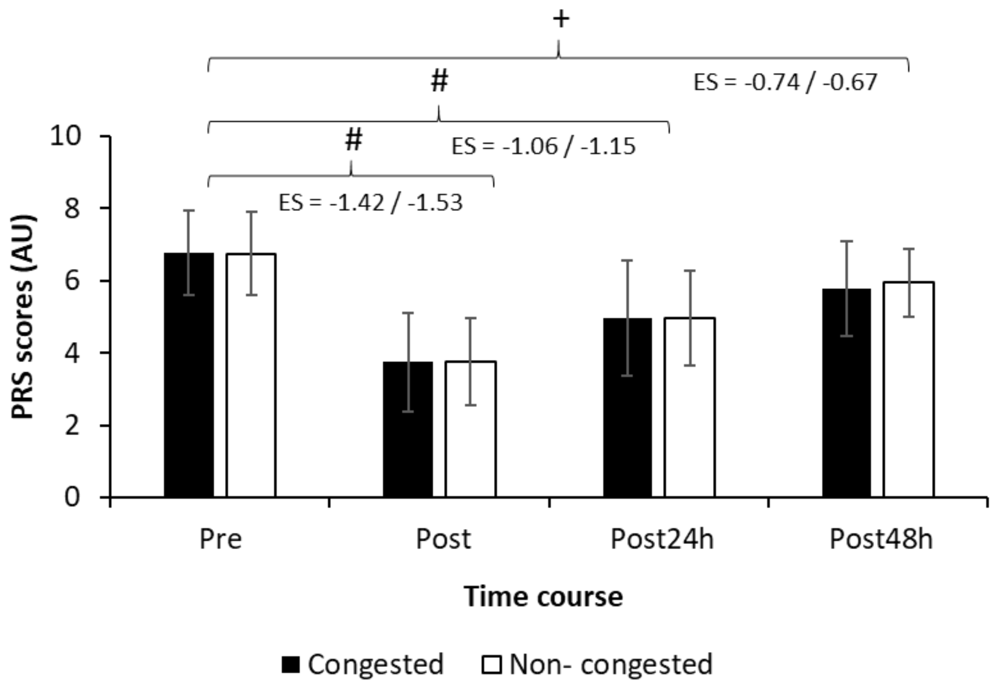

Figure 2. Time course to post-match recovery in congested and non-congested conditions.

ES = Congested / non-congested

Most likely decrease

+ Very likely decrease

External load

Apart from peak P_{met} during the first half, changes in external load measures between congested and non-congested matches were unclear. These results can be observed in Table 2.

Table 2. External load measures over congested and non-congested periods.

Variable	Game period	Non-congested	Congested	ES ± CI	Qualitative
Meters/min	First half	100.73 ± 8.92	101.31 ± 8.52	0.07 ± 0.50	Unclear
	Second half	94.08 ± 11.01	94.35 ± 7.39	0.06 ± 0.53	Unclear
	Full time	97.40 ± 9.39	97.93 ± 7.22	0.07 ± 0.52	Unclear
VHIA $_{VIFT}$ m/min	First half	9.61 ± 3.16	9.23 ± 3.22	-0.12 ± 0.49	Unclear
	Second half	8.80 ± 3.30	8.97 ± 3.02	0.07 ± 0.49	Unclear
	Full time	9.21 ± 2.91	9.10 ± 2.68	0.00 ± 0.51	Unclear
VHIA $_{MSS}$ m/min	First half	7.75 ± 3.65	7.72 ± 3.91	-0.05 ± 0.48	Unclear
	Second half	7.12 ± 3.23	7.63 ± 3.70	0.12 ± 0.48	Unclear
	Full time	7.44 ± 3.28	7.67 ± 3.48	0.05 ± 0.48	Unclear
High P_{met} m/min	First half	11.51 ± 3.05	11.56 ± 3.25	0.00 ± 0.48	Unclear
	Second half	10.50 ± 2.58	10.55 ± 2.69	0.00 ± 0.47	Unclear
	Full time	11.01 ± 2.59	11.05 ± 2.61	0.02 ± 0.49	Unclear
High P_{met} time/sec	First half	196.9 ± 36.7	198.4 ± 45.6	0.01 ± 0.47	Unclear
	Second half	181.3 ± 47.0	178.8 ± 30.4	-0.01 ± 0.53	Unclear
	Full time	378.2 ± 73.1	377 ± 61.3	-0.01 ± 0.51	Unclear
Peak P_{met} power	First half	170.4 ± 26.4	154.9 ± 24.9	-0.59 ± 0.46	Likely
	Second half	152 ± 27.3	160 ± 31.2	0.27 ± 0.47	Unclear
	Full time	161.2 ± 20.7	157.9 ± 19.5	-0.17 ± 0.49	Unclear

Correlations

We have observed a moderate association between $VHIA_{MSS}$ and perceptual recovery at pre (r = 0.45, CI 0.23 to 0.63), post (r = 0.43; CI 0.21 to 0.65) and post 24h (r = 0.35; CI 0.12 to 0.57). Additionally, distance covered at high P_{Met} were related with perceptual recovery at pre (r = 0.31; CI 0.08 to 0.53). We also found a large negative correlation between MSS and total of $VHIA_{MSS}$ performed in the match (r = -0.64; CI -0.83 to -0.46). In addition, a moderate negative correlation was observed between V_{IFT} and amount of $VHIA_{VIFT}$ (r = -0.33; CI -0.56 to -0.11).

4. **Discussion**

The aim of our study was to compare the internal (perceived recovery, sRPE and HR) and external (TD, VHIA and P_{met}) load responses between matches played under congested and non-congested fixtures in competitive youth soccer players. There was no clear effect of match condition on the perceived recovery responses during the four time points. However, independent of match condition perceived recovery was substantially impaired up to 48 h. During congested matches, percentage of time spent at HR_{high} was likely reduced during the first half. We also observed a most likely increase in internal training load during non-congested weeks. Amongst all external load measures obtained, only peak P_{Met} in the first half was likely lower during congested matches. No any other clear effects were observed over the congested match schedule. In the correlation analysis performed we observed perceptual recovery at pre, post and post 24 h to be moderate correlated with amount of $VHIA_{MSS}$ performed in the match. Furthermore, we found a large negative correlation between MSS and $VHIA_{MSS}$ and a moderate negative correlation between V_{IFT} and $VHIA_{VIFT}$ distances covered.

Previous research has shown the PRS to be sensitive to detect changes in sprint running performance and to somewhat indicate the presence of blood markers of muscle damage (Laurent et al., 2011; Sikorski et al., 2013). However, at least from the author knowledge no study has tested its utility with soccer players. We did not find any meaningful changes in perceived recovery between congested and non-congested matches in all time points. Our results are inconsistent with a recently investigation with elite youth players where perceptual recovery measures were substantially higher when match was played twice a week compared with once. (Hattersley et al., 2018). Potentially contextual factors that may increase mental and perceptual fatigue were not controlled in the present study (Paul, Bradley, & Nassis, 2015). In addition, the short period of data collection may provide some explanations for the differences observed (Rollo et al., 2014). Nevertheless, the current finds are in line with a recent study where intensified period of matches did not impair perceptual fatigue in youth soccer players (Gibson, McCunn, MacNay, Mullen, & Twist, 2018). Therefore, the present match schedule suggests that these short period of congested matches does not represent a higher physiological and psychological stress compared with a normal match programme of these particularly players. Our results provide a preliminary evidence of the time course of the recovery over a short congested period typically encounter in competitive youth schedules.

We have also observed that in both congested and non-congested conditions, perceived recovery was returned to baseline values before the following match. Therefore, it seems that 72 h was enough for these players perceive a fully recover. Time course to recover display conflicts results and recent systematic review revealed that adult soccer players may take more than 72 h to perceptually recover from a match (Silva et al., 2017). The reasons for the differences between the current with previous review can be explained by the sample age and the rate of recovery between youth and adult soccer players (Djaoui et al., 2016). Furthermore, given all the matches during the present schedule were followed by a win or draw, match related factors might have influenced the perceptual responses (Fessi & Moalla, 2018). Yet, perceived recovery was substantial lower in both conditions at post, post 24 h and post 48 h (~ 46 %, 18 % and ~ 13 %) respectively. The same time course to recovery have been previously reported with soccer players using other recovery scales (Malone et al.,2018; Thorpe et al., 2016). In addition, the present time course to recover displays similar patterns comparing with others neuromuscular and biochemical measures frequently used to monitor fatigue in youth soccer players (Hoyo et al., 2016).

Correlational analysis revealed that PRS score at pre, post and post 24 h were moderately associated with $VHIA_{MSS}$ and high P_{Met}.While VHIA have been linked with number of sprints, high P_{Met} has been associated with high intensity efforts such as accelerations and decelerations (Gaudino et al., 2013). Literature suggests that aforementioned locomotor activities are directed related to the extent of post-match neuromuscular fatigue (Nedelec et al., 2014). Therefore, the use of PRS should be attractive to sport science and medicine staff as a non-invasive and expeditious method to accurately monitor an individual's recovery status (Laurent et al., 2011). Additionally, it can be a useful method to identify player's readiness prior to an upcoming session. In this context, our results add to previous research where other well-being scales were able to provide information concerning the intensity output that can be expected from an individual player during a training session (Gallo et al., 2016, Malone et al., 2018) and matches (Ihsan et al., 2017).

Throughout the study period, internal load was assessed with sRPE. The players involved in the present study perceived both congested and non-congested matches as hard (~ 5.4 and 5.0 AU) respectively. These values are inferior as previous reported with youth soccer players (Moreira et al., 2016; Hattersley et al., 2018). The reason for the contrasting findings between the current and previous research could be related to the competition context and to the fact that lower sRPE values are normally reported after a win (Fessi & Moalla, 2018). During the present match schedule there was no clear effects in sRPE values between congested and non-congested matches. These results are in line with previous study with youth soccer players were during an intensified period of matches sRPE was unchanged (Moreira et al., 2016).

We have as well monitored all training sessions and observed training load and exposure to be consistent during the weeks where congested matches were played. However, during the non-congested weeks, before match 4 and 6, players were exposed to a greater number of trainings sessions, therefore to a higher overall training load. These common features have been previously reported during soccer schedules (Gallo et al., 2016). Nevertheless, to ensure optimal recovery, load was reduced two days before the match. However, the extent that higher and lower loads during non-congested and congested weeks respectively had any impact on match performance is unknown. Given match running performance did not vary during congested matches, it might be that due to lower training load between congested matches, players were able to maintain their performance.

Across the 8 matches, we have monitored HR responses at different zones during the halves. Data was further analysed according with player's individual maximum HR obtained in the 30-15_{IFT}. Therefore, during all matches we observed that players spent most of the playing time above 80 % of HR_{Max}. The same HR responses were previously observed with youth soccer players during 42 matches played over a period of 4 months (Mendez-Villanueva, Buchheit, Simpson, & Bourdon, 2013). Results showed that percentage of the time spent at HR high during congested matches was likely lower in the first half. Interesting, the same result was earlier reported in a congested schedule with youth players (Hattersley et al., 2018). In this study, time spent above 85 % of HR_{max} was likely decreased during the first half in a microcycle consisted of two matches compared with one. Further to this, Morh et al (2016) examined the effect of three matches played in the same week and detected average and peak HR reached in the match 1 to be higher compared with match 2 and 3. In both previous studies, higher HR was followed by an increase in running activities. Conversely, in our study, increases in HR high during the first half did not follow the same pattern. In fact, we have observed an unclear change in running variables between the two conditions. Assumed in our analysis data from all player's position were pooled together, these rather than other factors may have influenced the results (Alexandre et al., 2012). Furthermore, the fact that the same findings were not consistent during the second half and full time respectively makes difficult to drawn any further conclusion. Hence, despite HR being considered a valid measure of match intensity, further analysis is necessary to identify if the reductions observed in the first half during congested matches is resultant of player's drop in match intensity or just consequence of other factors that may influence HR during the match (Achten & Jeukendrup, 2003).

We have analysed during our intervention several measures of external load derived from the GPS device in a temporal and individualized approach. Therefore, we did not find any substantial changes in external measures of running performance between congested and non-congested matches. This was the first study in congested fixture to look at P_{met} variables as a way to quantify high intensity actions. These movements have been shown to impose high mechanical and metabolic stress on the players during the match (Osgnach et al., 2010). The P_{met} values found in our study are the same as previous reported for elite soccer players during five pre-season matches (Hoppe et al., 2017). However, they differ from the results of Ogsnach et al. (2010) that measured P_{met} from 399 players from Italia "Serie A" league through video analysis. The differences from previous with the present study can be due to the distinct technologies used to measure P_{met} (e.g. GPS vs video analysis). We demonstrated in our analysis that time and distance spent at high P_{met} do not differ between congested and non-congested schedules. The results observed in our study are novel given no previous research in congested fixture have used P_{met} approach as a way to estimate energy cost during accelerations and decelerations. Analysis of the accelerations and body impacts were indeed measured using a different approach during a very congested match schedule with youth soccer players (Arruda et al., 2015). In this study, the authors suggest that frequency of accelerations and body load impacts per minute have been deteriorate across a tournament were 5 matches were played over 3 consecutive days (Arruda et al., 2015). Compared with our study, differences can be explained by the match schedule where data was collected. These sequence of matches do not represent the normal season programme of competitive youth soccer players where matches are played at least respecting 72 h of interval suggested by FIFA (Soligard et al., 2016). According with our study, a short period of congested matches with time to recovery ≥ 72 h did not impact high intense actions such as accelerations and decelerations measured by the time and estimated distance spent at high P_{met}. On the other hand, peak P_{met} was likely lower in the first half during congested matches. However, given in our study we have observed Peak P_{met} to vary ~ 12 % between matches, moderate reductions may be due to the normal match to match variation. Therefore, further analysis using P_{met} approach is needed to stablish a more precise conclusion.

To assess match-play running intensity distribution, we classified the speed zones in two different approaches (MSS and V_{IFT}). The use of individualized speed thresholds based on player's physical capacity has been suggested as an alternative to account for individual load responses (Lovell & Abt, 2013). In our study, similar distance at different speed thresholds were observed when compared with previous research including youth soccer players (Buchheit et al., 2011; Rowsell et al., 2011). Our results suggest that total distance reported relatively to minutes played displayed similar values during first and second half between the two conditions. We have observed different value in VHIA when velocity bands were classified according with MSS and V_{IFT}. These alterations were ~ 17 % greater in $VHIA_{VIFT}$ compared with $VHIA_{MSS}$ during both conditions. Moreover, when VHIA was individualized according with MSS, VHIA was large underestimated in faster players. On the other hand, when settled according with $V_{IFT,}$ VHIA was to a less extend underestimated in players with high intermittent capacity. The same pattern has been previously demonstrated during a study where different methods were used to individualize speeds thresholds (Hunter et al., 2015). When analysing the halves, different results were observed. While $VHIA_{MSS}$ was slight greater in the second half in congested matches, $VHIA_{VIFT}$ was greater in non-congested during the first half. However, there was no meaningful changes in VHIA in any of the two speed classifications during congested and non-congested matches. Our results are contrasting with previous research in youth players where match running performance was deteriorated over successive matches (Buchheit et al., 2011; Hattersley et al., 2018; Rowsell et al., 2011). As earlier mentioned, the contrasting results could be related to the window of recovery (≥ 72h) observed in our schedule. The aforementioned studies have played successive matches between 24 h (Rowsell et al., 2011) and 48 h (Buchheit et al., 2011) of recovery only. Furthermore, they have used fixed speed thresholds which may have masked individual dose responses (Hattersley et al., 2018). Even though, our results are in agreement with the study by Duppont et al. (2010) were 72-96h were sufficient to maintain the levels of match running performance during matches played twice a week. In addition, the present study has collected data during a similar congested schedule and found similar results compared with previous research with elite soccer players (Carling, Gall, & Dupont, 2012).

There is a general agreement that match running performance might be influenced by a myriad of contextual factors (Paul et al., 2015). Being so, we cannot exclude the influence of opponent standard, match results (i.e. scoring earlier in the game), game location and other contextual factors that may had influenced the observed results (Paul et al., 2015). For instance, when teams are winning matches, while ball possession is increased, high intensity activities tends to decrease (Bloomfield, Polman, & O'donoghue, 2005). Given winning is a comfortable result, teams therefore tend to slow down the match intensity, which in turn results in higher low speeds (Bloomfield et al., 2005). In the present study, matches played under congested condition were played against the strongest teams (<6th position). As a consequence, 64 % of the goals during this condition were scored in the second half. This means that players might had to maintain the high intensity of the match for longer, therefore increasing match output. Conversely, during non-congested matches 66.3 % of goals were scored in the first half, therefore players may have adopted a conscious pacing strategy in the second half in order to save fitness for subsequent match that will be played in few days (Paul et al., 2015; Waldron & Highton, 2014). This might explain the reason HR and peak P_{met} were higher in the first half only. Therefore, future analysis in congested fixture should control for different contextual factors that might influence match running performance. This can be achieved with large sample size, robust research designs and use of a multivariate statistical analyses.

During our study fatigue was measured using a novel subjective recovery scale. Although scientific legitimated and players been familiarized with its use, true perception of recovery might have been influenced by players under or over reported to cope with distinct circumstances during the match schedule. Additionally, as previous research in congested fixture (Hattersley et al., 2018), our results are limited by the small sample size (10 players). Despite in our analysis we have included only those who were really exposed to congested matches and played more than 85 % of the total match time, our results may have been in parts influenced by player's rotation during the sequence of matches. For example, in the period of the study only one player has played full time all the 8 matches. These in turn may question the extent players are really exposed to match congestion (Carling et al., 2015). Another limitation is the fact that due to small sample size, in our statistical analysis we have pooled the data together. Therefore, individual responses may have been ignored, particularly during matches played under congested conditions. For instance, research suggests that during match congested changes in match running performance affects players differently (Varley, Di Salvo, Modonutti, Gregson, Mendez-Villanueva, 2018). Therefore, future research should also aim collect data from a large sample sizes and analyse players individually.

5. **Conclusion**

In conclusion, our data suggest that during a short competitive schedule no substantial changes exist in the internal (perceptual fatigue, sRPE and HR) and external (TD, VHIA and P_{met}) load responses between matches played under congested and non-congested conditions. We have also observed that 72 h might be sufficient time for competitive youth soccer player's perceptually recover from a match played under both conditions. However, coaches should avoid hard sessions in the period up to 48 h after the match, since players are still under residual effect of post-match fatigue. This study also has shown the PRS to be a cost effective method of monitoring perceptions of recovery during congested schedules, as well as, being sensitive to detect changes in the time course response to soccer activity. Furthermore, the use of this non-invasive and simple measure has been shown moderate association with external load, therefore it can be used not only as a method to quantify fatigue, as well to somehow predict match output. During long weeks of training, coaches should control the training load wisely in order to avoid players arrive to the match under recovered. Additionally, to keep match intensity during congested schedules it might be important to attempt for player's rotation. Our results also recommend when individualize speed thresholds according with player's physical capacity, practitioners should avoid the use of a single measure. We have observed percentage of time spent at HR high and peak P_{met} to be likely reduced in the first half during congested matches. However, a more robust research design and further data is needed to confirm these results. Therefore, a short period of congested matches with an interval of $\geq$ 72 h was not sufficient to increase perceptual fatigue or impair performance compared with non-congested in competitive youth soccer players. Despite the short period of analysis might not been sufficient to cause any accumulated fatigue and performance losses, these results limit the generalization of our findings to other scenarios of congested schedule.

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Appendix A

Ethics Application

1) Name of proposer(s)	Luiz Gustavo Nunes Tomazoli
2) St Mary's email address	155909@live.stmarys.ac.uk
3) Name of supervisor	Stephen Patterson and Mark Waldron

4) Title of project
Internal and External Load Responses between Congested and Non- Congested Matches in Youth Soccer Players

5) School or service	School of health and applied science
6) Programme (whether undergraduate, postgraduate taught or postgraduate research)	Postgraduate research
7) Type of activity/research (staff/undergraduate student/postgraduate student)	Post graduate student

8) Confidentiality	
	YES

Will all information remain confidential in line with the Data Protection Act 1998?	
9) Consent	
Will written informed consent be obtained from all participants/participants' representatives?	YES

10) Pre-approved protocol	
Has the protocol been approved by the Ethics Sub-Committee under a generic application?	No Date of approval:

11) Approval from another Ethics Committee	
a) Will the research require approval by an ethics committee external to St Mary's University?	No
b) Are you working with persons under 18 years of age or vulnerable adults?	YES

12) Identifiable risks	
a) Is there significant potential for physical or psychological discomfort, harm, stress or burden to participants?	NO
b) Are participants over 65 years of age?	NO
c) Do participants have limited ability to give voluntary consent? This could include cognitively impaired persons, prisoners, persons with a chronic physical or mental condition, or those who live in or are connected to an institutional environment.	NO

d) Are any invasive techniques involved? And/or the collection of body fluids or tissue?	NO
e) Is an extensive degree of exercise or physical exertion involved?	YES
f) Is there manipulation of cognitive or affective human responses which could cause stress or anxiety?	NO
g) Are drugs or other substances (including liquid and food additives) to be administered?	NO
h) Will deception of participants be used in a way which might cause distress, or might reasonably affect their willingness to participate in the research? For example, misleading participants on the purpose of the research, by giving them false information.	NO
i) Will highly personal, intimate or other private and confidential information be sought? For example, sexual preferences.	NO
j) Will payment be made to participants? This can include costs for expenses or time.	NO
k) Could the relationship between the researcher/ supervisor and the participant be such that a participant might feel pressurised to take part?	NO
l) Are you working under the remit of the Human Tissue Act 2004?	NO

13) Proposed start and completion date

Please indicate:

- When the study is due to commence.
- Timetable for data collection.
- The expected date of completion.

Please ensure that your start date is at least 3 weeks after the submission deadline for the Ethics Sub-Committee meeting.

The study will start on the 1st January 2018 and expected to be completed on the 31st May 2018. Please find bellow the timetable (matches) for data collection.

7/02/18	12-02-18	15-02-18	18-02-18	25-02-18	28-02-18	11-03-18	14-03-18	17-03-18	31-03-18

14)Sponsors/Collaborators-

Please give names and details of sponsors or collaborators on the project. This does not include your supervisor(s) or St Mary's University.

- Sponsor: An individual or organisation who provides financial resources or some other support for a project.

- Collaborator: An individual or organisation who works on the project as a recognised contributor by providing advice, data or another form of support.

Al Sadd Sports Club

Al Sadd, P.O BOX 29222

Doha, Qatar http://al-saddclub.com

15. Other Research Ethics Committee Approval
• Please indicate whether additional approval is required or has already been obtained (e.g. the NHS Research Ethics Committee). • Please also note which code of practice / professional body you have consulted for your project. • Whether approval has previously been given for any element of this research by the University Ethics Sub-Committee
Not applicable

16. Purpose of the study
In lay language, please provide a brief introduction to the background and rationale for your study. *[100 word limit]* • Be clear about the concepts / factors / performances you will measure / assess/ observe and (if applicable), the context within which this will be done. • Please state if there are likely to be any direct benefits, e.g. to participants, other groups or organizations.
In modern soccer different competitions are played simultaneously, which require players to play a high number of matches in a short period of time. These intense periods are known as congested fixture and have been shown to increase mental and physical fatigue, increase the

chances of injury occurring and delay the recovery between games. Therefore, the aim of this study is to observe the differences in internal and external load between a period of congested and non-congested match fixtures in under 19 soccer players. The result of this study may provide insight into these intense periods, helping coaches plan their sessions accordingly.

17. Study Design/Methodology

In lay language, please provide details of:

a) The design of the study (qualitative/quantitative questionnaires etc.)
b) The proposed methods of data collection (what you will do, how you will do this and the nature of tests).
c) You should also include details regarding the requirement of the participant i.e. the extent of their commitment and the length of time they will be required to attend testing.
d) Please include details of where the testing will take place.
e) Please state whether the materials/procedures you are using are original, or the intellectual property of a third party. If the materials/procedures are original, please describe any pre-testing you have done or will do to ensure that they are effective.

a) A prospective study that will quantify the external and internal load of U19 soccer players from a first division club in Qatar. External load has been defined as the load completed by the athlete, independently of their internal characteristics (e.g. distance covered, number of accelerations and metabolic power) while internal load is how the athlete physiologically and psychologically experienced that external load (e.g. heart rate responses, psychometric scales).
   Data will be collected across 10 sequential matches during the month of February and March 2018. The study will be quantitative in nature with comparisons made within the group between congested and non-congested fixtures.

b) The matches will be distributed as follows:

- Matches ,3,4,6,8 and 9 played with less than 72 hours of interval (congested fixture)
- Matches 1,2,5,7 and 10 will be played with more than 72 hours of interval (non-congested)

During all matches players will be fitted with a global positioning system (GPS), located at upper back between the scapulae housed in a tight-fitting garment to reduce movement artefact. The MEMS device features an integrated IMU with triaxial accelerometer. The GPS units will be turned on just before the warm-up (~ 30 min) prior to each game. Data will be analysed relative to player's individual peak velocity.

The Perceived recovery scale will be assessed individually on a scale of 0 (very poorly recovered/extremely tired) to 10 (very well recovered/highly energetic) with players asked "how do you feel?" in the 4 time points

- 30min before all matches (before warm-up)
- 30 min after all matches
- 24h after all matches
- 48 h after all matches

The rate of perceived exertion (RPE) will be collected after all matches, as well as, after all the training sessions during the period of data collection.

One week before the first match, players will be tested for:

1) maximum speed velocity (40 m)

2) maximal aerobic speed -30-15 IFT (MAS).

The tests will be performed in the first session of the week after a day off.

In order to better understand the locomotor profile of the players through GPS data, the speed thresholds for each athlete will be individualized according to their actual fitness attributes using the result of the physical tests mentioned above.

Equipment that will be utilized in the study:

- Race Time 2, Microgate S.r.I., Via Stradivari, 4, 39100 Bolzano – Italy
- Sound system (MAS)
- Tri-axil accelerometer sample (Catapult OptimEye S5) frequency of 100Hz
- Perceived recovery scale (0-10)
- Modified CR10 Borg scale

c) All participants will be required to perform the physical tests one week before the commence of the study. During the day of the test participants will be required to arrive at the club before one hour. First they will perform a maximal speed test followed a VMA test. All the session will last approximately 40-50 mins.
d) Qatar
e) All the equipment is original and have been previously shown in other research projects to be sensitive and reliable.

Reference:

- Buchheit, M., Mendez-Villanueva, A., Simpson, B. M., & Bourdon, P. C. (2010). Match running performance and fitness in youth soccer. *International Journal of Sports Medicine*, *31*(11), 818-825.

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- Coutts, A. J., & Duffield, R. (2010). Validity and reliability of GPS devices for measuring movement demands of team sports. *Journal of Science and Medicine in Sport*, *13*(1), 133-135.

- Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., Doleshal P., & Dodge, C. (2001). A new approach to monitoring exercise training. *The Journal of Strength & Conditioning Research*, *15*(1), 109-115.78.

- Laurent, C. M., Green, J. M., Bishop, P. A., Sjökvist, J., Schumacker, R. E., Richardson, M. T., & Curtner-Smith, M. (2011). A practical approach to monitoring recovery: Development of a perceived recovery status scale. *The Journal of Strength & Conditioning Research*, *25*(3), 620-628.

- Hunter F, Bray J, Towlson C, et al. Individualisation of time-motion analysis: a method comparison and case report series. Int J Sports Med. 2015;36(1):41–48.

- Mendez-Villanueva A, Buchheit M, Simpson B, Bourdon PC.Match play intensity distribution in youth soccer. Int J Sports Med.2013;34(2):101–110.

- Lacome M, Piscione J, Hager JP, Bourdin M. A new approach to quantifying physical demand in rugby union. J Sports Sci. 2014;32(3):290-300.

- Malone J.J, Lovel R, Varley,MC. Umpacking the black box.Applications and considerations for use GPS devices in sports.International Journal of Sports Physiology and Performance, 2017, 12, S2-18 -S2-26.

- Gabbet, TJ. Use of relative speed zones increases the high speed running performed in team sport match play.Journal of Strength & Conditioning Research:2015, 29 (12),3353-3359.

18. Participants

Please mention:

a) The number of participants you are recruiting and why. For example, because of their specific age or sex.
b) How they will be recruited and chosen.
c) The inclusion/exclusion criteria.
d) For internet studies please clarify how you will verify the age of the participants.
e) If the research is taking place in a school or organisation then please include their written agreement for the research to be undertaken.

a. The study will recruit 24 male youth soccer players (age range 17 to 19) belonging to a first division club in Qatar.The sample size was calculated using a G* Power for repeated measures ANOVA (within-between interaction) with an effect size 0.25, error 0.05 and power of 0.80. The average effect size has been used in previous research with other subjective scales.
   Participants have a large training background (5-9 years) with an average exposure of 1.5 hour daily, 5 times a week and an average of one match per week
b. Participants recruited belongs to the U19 squad of Al Sadd Sports Club- Doha, Qatar

c. Participants will be included if they complete all the physical tests. During the data analysis only those that have repeatedly played more than 80% of the total match time will be included. Participants will be excluded if they sustain any match related injury or illness that prevent from participating in any session during the week that precedes the next game
d. Not applicable
e. The research will take place with players from the U19 squad of Al Sadd Sports Club. A consent letter from the club will be attached together with ethical application form.

Reference:

Gallo, T. F., Cormack, S. J., Gabbett, T. J., & Lorenzen, C. H. (2016). Pre-training perceived wellness impacts training output in Australian football players. *Journal of Sports Sciences*, *34*(15), 1445-1451.

Ihsan, M., Tan, F., Sahrom, S., Choo, H. C., Chia, M., & Aziz, A. R. (2017). Pre-game perceived wellness highly associates with match running performances during an international field hockey tournament. *European Journal of Sport Science*, *17*(5), 593-602.

Malone, S., Owen, A., Newton, M., Mendes, B., Tiernan, L., Hughes, B., & Collins, K. (2017). Wellbeing perception and the impact on external training output among elite soccer players. *Journal of Science and Medicine in Sport*, (3), 0-19

19. Consent

If you have any exclusion criteria, please ensure that your Consent Form and Participant Information Sheet clearly makes participants aware that their data may or may not be used.

a) Are there any incentives/pressures which may make it difficult for participants to refuse to take part? If so, explain and clarify why this needs to be done

b) Will any of the participants be from any of the following groups?

- Children under 18
- Participants with learning disabilities
- Participants suffering from dementia
- Other vulnerable groups.

c) If any of the above apply, does the researcher/investigator hold a current DBS certificate? A copy of the DBS must be supplied **separately from** the application.

d) How will consent be obtained? This includes consent from all necessary persons i.e. participants and parents.

a) The person responsible for the data collection work as strength and condition coach for the participants age group. This fact may present some kind of pressure in the players to accept to take part in the study. However, participants are registered with the local federation for the club and compete for the official category championship which makes his participation in the games compulsory.
b) Under 18
c) Yes
d) A written consent form will be singed before the study starts for those above 18 years old, as well as, for their parent's for those under 18 years old. All the participants, as well as, their parents can understand English and translation of the document into another language will not be necessary.

20. Risks and benefits of research/ activity

a) Are there any potential risks or adverse effects (e.g. injury, pain, discomfort, distress, changes to lifestyle) associated with this study? If so please provide details, including information on how these will be minimised. b) Please explain where the risks / effects may arise from (and why), so that it is clear why the risks / effects will be difficult to completely eliminate or minimise. c) Does the study involve any invasive procedures? If so, please confirm that the researchers or collaborators have appropriate training and are competent to deliver these procedures. Please note that invasive procedures also include the use of deceptive procedures in order to obtain information. d) Will individual/group interviews/questionnaires include anything that may be sensitive or upsetting? If so, please clarify why this information is necessary (and if applicable, any prior use of the questionnaire/interview). e) Please describe how you would deal with any adverse reactions participants might experience. Discuss any adverse reaction that might occur and the actions that will be taken in response by you, your supervisor or some third party (explain why a third party is being used for this purpose). f) Are there any benefits to the participant or for the organisation taking part in the research (e.g. gain knowledge of their fitness)?
a) Participants will perform a maximum velocity and maximum aerobic speed test before the study starts. Despite the fact that those physical tests are maximum and may increase the risk of muscle injury occur, all the participants are used to take part of these tests at least 3 times a year. Furthermore, a proper warm-up of 10 min will be performed before the tests which in turn minimize the risks. b) Other risks can arise from the matches itself. However, the participants are enrolled in the sport for at least 5 years and accustomed with this type of sport, which probably decrease the risk. Furthermore, all testing will take place at a professional soccer club where trained first aiders will be available if an injury was to occur. c) No invasive procedure will be used in this study d) Questionnaires such as perceived recovery scale (PRS) and rate of perceived exertion (RPE) will be used during this study. These questionnaires will be important to identify how participants are responding to the stimulus and to ensure that they are able to compete in a football match.

e) In all the matches played during the study period the ambulance will be present, therefore if any major problem happens, the medical staff will provide a necessary support.
f) Participants will benefit from this study in a way that they will be aware of the internal and external load experienced by them during the matches played. As well, how to best maximize their performance during a period with consecutive matches.

21. Confidentiality, privacy and data protection

a) What steps will be taken to ensure participants' confidentiality?

- Please describe how data, particularly personal information, will be stored (all electronic data must be stored on St Mary's University servers).
- Consider how you will identify participants who request their data be withdrawn, such that you can still maintain the confidentiality of theirs and others' data.

B) DESCRIBE HOW YOU WILL MANAGE DATA USING A DATA A MANAGEMENT PLAN.

- YOU SHOULD SHOW HOW YOU PLAN TO STORE THE DATA SECURELY AND SELECT THE DATA THAT WILL BE MADE PUBLICALLY AVAILABLE ONCE THE PROJECT HAS ENDED.
- YOU SHOULD ALSO SHOW HOW YOU WILL TAKE ACCOUNT OF THE RELEVANT LEGISLATION INCLUDING THAT RELATING DATA PROTECTION, FREEDOM OF INFORMATION AND INTELLECTUAL PROPERTY.

c) Who will have access to the data? Please identify all persons who will have access to the data (normally yourself and your supervisor).

d) Will the data results include information which may identify people or places?

- Explain what information will be identifiable.
- Whether the persons or places (e.g. organisations) are aware of this.
- Consent forms should state what information will be identifiable and any likely outputs which will use the information e.g. dissertations, theses and any future publications/presentations.

Data for the participants will be treated confidentially and all of them will have a code identifier. Their identity will not be exposed during presentation or publication of the results. All the information obtained during the study will be stored in a personal computer at St Mary's university server for 10 years with restrict access of the investigator (Luiz Tomazoli), as well as, the supervisors (Stephen Patterson and Mark Waldron). The data collected will be used as part of Luiz's thesis and if there is a chance it will be published in a scientific journal.

22. Feedback to participants
Please give details of how feedback will be given to participants: • As a minimum, it would normally be expected for feedback to be offered to participants in an acceptable to format, e.g. a summary of findings appropriately written. • Please state whether you intend to provide feedback to any other individual(s) or organisation(s) and what form this would take.
Informal feedback will be given to the participants and coaches in the end of the study.

The proposer recognises their responsibility in carrying out the project in accordance with the University's Ethical Guidelines and will ensure that any person(s) assisting in the research/ teaching are also bound by these. The Ethics Sub-Committee must be notified of, and approve, any deviation from the information provided on this form.

Signature of Proposer(s)	Date: 21/10/2017

Signature of Supervisor (for student research projects)	Date:6.11.17

Appendix B

Information sheet

Section A- The research project

St Mary's University
Waldegrave Road, Strawberry Hill, Twickenham, London TW1 4SX
T: 020 8240 40000 / F: 020 8240 4255
www.stmarys.ac.uk

- Title of the project:
-

Internal and External Load Responses between Congested and Non- Congested Matches in Youth Soccer Players

- Purpose and value of the study:

This study has the aim to to observe the differences in internal and external load between a period of congested and non-congested match fixtures with under 19 soccer players.

- Invitation to participate

I invite you to take part in this research study organized by myself, Luiz Gustavo Nunes Tomazoli, postgraduate student of St Mary's University. Hopefully, your participation in the
study will provide us information that will benefit you and others in the future.

- Who is eligible to participate in the study:

All active soccer players from Al Sadd Sports club with aged between 17-19 years' old and injury free.

Luiz Gustavo Nunes Tomazoli

Tel: +974 55028571
Luizgustavo.tomazoli@aspetar.com

Section B- Your participation in the research project

- Why you have been selected to participated in this study

You have been selected because you are part of the under 19 squad of Al Sadd Sports Club-Doha, Qatar. However, if you refuse to participate in the study, this will not affect any right or benefit you already have. As well, if you decide to stop being part of the study, this can be done at any time without any loss or penalty.

- What will happen if you agree to take part of the study?

If you decide to be part of this study, you will be requested to perform two physical tests one week before the start of the data collection. You will be required to perform the maximal sprint performance test and MAS test. Then, during the 10 matches, approximately 30 mins before the match you will be fitted with a GPS unit at the upper back between the scapulae. Additionally, during the time course of the match you will be asked to self-report a recovery questionnaire PRS. You will also be asked during the study period to report daily after all sessions and after all matches your rate of perceived exertion RPE in a modified 0-10 scale. During the study period you will be required to perform a maximum sprint test and MAS test, as well as, play an official soccer match witch may increase the chances of injury occur. However, in case of any problem during the study period an immediate medical support will be provided.
You will benefit from this study, given the results may possibly provide important information regarding the real burden that periods of congested fixture may impose over soccer players. This information will allow practitioners and athletes to take effective actions in order to accelerate the recovery process, as well as, make modifications in training programmes.

- What will happen with the data?

The results of this study will be submitted to St Mary’s university as part of the research project. Your identity and data relating to this study will be kept confidential and will not be
given to anyone unless I get your permission in writing. You are free to ask any question during and after the study period.

If you require any other information, please do not hesitate to contact me direct in the email mentioned above.

If you decide to take part in this research study, your parents (underage) or you will be asked to sign the consent form and you will be given a copy for your records.

Appendix C

Parental Consent Form

Name of Participant: ____

Title of the project: Internal and External Load Responses between Congested and Non-Congested Matches in Youth Soccer Players

Main investigator and contact details: Luiz Gustavo Nunes Tomazoli,
Mail: 155909@live.stmarys.ac.uk

Members of the research team: Luiz Tomazoli, Stephen Patterson and Mark Waldron

1. I agree to my child taking part in the above research. I have read the Participant Information Sheet which is attached to this form. I understand what my child's role will be in this research, and all my questions have been answered to my satisfaction.
2. I understand that I am free to withdraw my child from the research at any time, for any reason and without prejudice.
3. I have been informed that the confidentiality of the information I and my child provides will be safeguarded.
4. I am free to ask any questions at any time before and during the study.
5. I have been provided with a copy of this form and the Participant Information Sheet.

Data Protection: I agree to the University processing personal data which I and my child have supplied. I agree to the processing of such data for any purposes connected with the Research Project as outlined to me.

Name of parent
(print)………………………………………………………………………………..

Signed………………..…………………
Date…………………………….........

If you wish to withdraw your child from the research, please complete the form below and return to the main investigator named above.

Title of Project:
____

I WISH TO WITHDRAW MY CHILD FROM THIS STUDY

Name of Participant:
____

Name of Parent

____

Signed: ________________________________ Date: ________________

Appendix D

Consent Form

Name of Participant: ____

Title of the project: Internal and External Load Responses between Congested and Non-Congested Matches in Youth Soccer Players

Main investigator and contact details: Luiz Gustavo Nunes Tomazoli,
Mail: 155909@live.stmarys.ac.uk

Members of the research team: Luiz Tomazoli, Stephen Patterson and Mark Waldron

1. I agree to take part in the above research. I have read the Participant Information Sheet which is attached to this form. I understand what my role will be in this research, and all my questions have been answered to my satisfaction.
2. I understand that I am free to withdraw from the research at any time, for any reason and without prejudice.
3. I have been informed that the confidentiality of the information I provide will be safeguarded.
4. I am free to ask any questions at any time before and during the study.
5. I have been provided with a copy of this form and the Participant Information Sheet.

Data Protection: I agree to the University processing personal data which I have supplied. I agree to the processing of such data for any purposes connected with the Research Project as outlined to me.

Name of participant
(print)………………………………………………………………………..

Signed………………..…………………
Date………………………….........

If you wish to withdraw from the research, please complete the form below and return to the main investigator named above.

Title of Project:
____

I WISH TO WITHDRAW FROM THIS STUDY

Name: ____

Signed: __________________________________ Date: ____________________

Appendix E

Club Letter to Conduct the Research Project

AL-SADDCLUB.COM

28th November 2017

To whomsoever it may concern

This is to confirm on behalf of Al-Sadd Sports Club that Mr. **Luiz Gustavo Nunes Tomazoli**, physical coach of U-19 Football team was requested for authorization to conduct a research project within the Club. We would like to ensure our support to this research project as we believe it is interesting and feasible to be realized at the Club facilities.

Therefore, we authorize him to conduct this research within our Club, collecting information from our football players as subjects, since they consent with the procedures describes in the project.

Best regards,

TURKI NASSER AL-MAADHEED
GENERAL MANAGER

TEL +974 4444 8080 | FAX +974 4444 8091 | P.O. BOX 2122 | DOHA - QATAR | ALSADD@MCS.GOV.QA